Towards Interactive Narrative Medicine

Marc CAVAZZA (MD, PhD) and Fred CHARLES (PhD)
Teesside University, School of Computing, United Kingdom

Abstract. Interactive Storytelling technologies have attracted significant interest in the field of simulation and serious gaming for their potential to provide a principled approach to improve user engagement in training scenarios. In this paper, we explore the use of Interactive Storytelling to support Narrative Medicine as a reflective practice. We describe a workflow for the generation of virtual narratives from high-level descriptions of patients’ experiences as perceived by physicians, which can help to objectivize such perceptions and support various forms of analysis.

Keywords. Narrative Medicine, Virtual Reality, Interactive Storytelling.

Introduction and Rationale

Serious gaming has revisited previous work on simulation and training by providing a better context of engagement and interaction, borrowing from the gameplay and narrative aspects of computer games. However, the development process of serious games remains a largely empirical approach, one that blends creative aspects with the constraints of a professional application. Although iterative development with regular feedback from stakeholders can ensure the satisfactory behavior of the end product, one of the main challenges facing serious games in Medicine lies in the articulation of gameplay principles and rigorous clinical concepts. This is of particular relevance when addressing problems at the interface of clinical skills and “soft skills” such as patient education [8] [9] [12] [13] and patient-doctor relationships.

The recent development of Narrative Medicine [2] [3] within Medical curricula introduces a framework into which patient history can be described, providing a more rigorous basis to physicians in their effort to understand their patients’ personal (and illness-related) histories [7]. In particular, Narrative Medicine posits that narratives are the phenomenal form through which patients experience illness [7], but this finding promotes empathy, a more holistic management, and even a more creative attitude towards treatment.

The objective of this research is to support the development of virtual reality as a medium for narrative medicine², using recent developments in Interactive Storytelling [11]. This should advance the state-of-the-art beyond the use of Interactive Storytelling in training or serious gaming, in which narrative aspects have often been described empirically as part of system or “gameplay” design. The originality of our approach lies in the use of Narrative Medicine concepts in the design of an Interactive

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¹ Corresponding author: m.o.cavazza@tees.ac.uk

² Although narrative medicine refers primarily to text as a medium, some case studies for narrative medicine have included different media such as film [15].
Storytelling system aimed at medical applications. This should provide a more relevant and consistent basis than knowledge derived from narratology or entertainment theory.

Interactive Storytelling Principles

The aim of Interactive Storytelling is to achieve a balance between interactivity and narrative content by relying on explicit models of plot progression or characters’ motivations [1]. Its potential for educational application derives from the knowledge content of the underlying explicit narrative representations. Because an Interactive Narrative preserves the consistency of the baseline scenario, whilst propagating the consequences of user’s actions, it allows the exploration of this embedded knowledge by the user. Interactive Storytelling is also a privileged context into which to investigate affective aspects, through users’ empathy with characters or their response to dramatic progression. Narrative Generation is at the heart of Interactive Storytelling: it uses AI Planning techniques to generate a sequence of actions, from a set of initial constraints [11]. This sequence of actions is visualized in real time featuring virtual characters: the next section describes the application of Interactive Storytelling techniques to Narrative Medicine.

Figure 1. Generation of a patient-specific narrative from a questionnaire.
Narrative Generation for Narrative Medicine

The objective of this work is to leverage on narrative generation technology in order to allow an exploration of narrative medicine concepts themselves. To some extent, it automates the dramatization and the staging of the patient’s medical history to produce a 3D animation film. Narrative Medicine is aimed primarily at physicians, and although it has proven beneficial on patient-doctor relationships and their clinical practice at large [2] [7], it still requires a significant effort in the acquisition of narrative competencies.

The form of narrative generation we advocate has the potential to lower the access barrier to Narrative Medicine, by allowing physicians with little inclination for writing to produce visual media from questionnaires, and develop their narrative competency through their observation. One possible application of this approach is objectivize the perception by the physician of their patient experience and history (Figure 1). This should also allay some of the concerns expressed by physicians about Narrative Medicine promoting a subjective approach potentially incompatible with the objective, evidence-based nature of their diagnostic and therapeutic activity.

Figure 2. Patient pathway through the hospital from admission to treatment and recovery.
System Overview and Results

We have developed a hospital virtual environment using a state-of-the-art game engine, namely the Unreal® Development Kit (UDK)\(^3\). We have developed 3D graphical contents to include a wide range of hospital departments with all required stations for admissions, administration, diagnostics (including MRI and X-Ray, as well as standard examination rooms – see Figures 2 and 3), as well as a small operating theatre. The hospital virtual environment also required the creation of an appropriate and varied set of characters: medical and nursing staff, office staff and a range of patients (Figure 4). These characters are associated relevant animations to represent their interactions with the hospital virtual environment (objects and other characters). Characters’ actions constitute the building blocks of any narrative, and their visualization is subordinated to symbolic representations for the elementary actions that constitute the narratives.

The most important element of our system is a set of parameterized action representations, based on the PDDL planning formalism\(^5\), which are associated with appropriate 3D animations. These constitute the building blocks of the narrative, and can be dynamically recombined to assemble a patient’s unique story. The process by which a patient-specific narrative can be generated is illustrated on Figure 1. Narrative Medicine concepts inform the strategy by which elementary situations are assembled into a story. Emphasis on the patient’s viewpoint and the progressive construction of meaning drives the relationships between story and discourse in the actual staging of clinical actions. This approach capitalized on our previous work in viewpoint-based interactive narratives\(^10\).

The importance of empathy as a research concept encourages more formal explorations of narrative structure as a shared model of the illness’ history. One strategy that can be used to explore this aspect is to compare patient and physician reports of the same events. Both the physician and the patient can be asked to fill in a questionnaire describing their perception of various episodes in the patient history. Such data can then be used to parameterize narrative actions describing typical elements of the clinical history, which are subsequently ordered using semantic and temporal properties extracted from the same data, and eventually turned into a 3D narrative representing the patient history as derived from the physician’s viewpoint. This generation can in turn be used to reflect upon the physician’s perception and compare viewpoints across groups of health professionals.

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\(^3\) [http://www.unrealengine.com/udk] [07 November 2012]
The objective of virtual narrative generation is to integrate the elements given in the online report into a consistent narrative, which can be in turn examined, by the physician or their colleagues to explore their perception of the patient’s experience. The online questionnaire should include modalities associated to typical actions to be recorded: for instance, the waiting time on admission, the clarity of explanations, the atmosphere during X-ray examinations, and so on. Since each narrative action includes several modes of dramatization, the system performs a specific mapping between the questionnaire description and the dramatic presentation of the corresponding action. The resulting narrative will make visible the perception by the physician of the patient’s experience and will open it to scrutiny. It will enable exploration by the physician of their own perception by altering the description of specific events before regenerating the overall narrative. It will also allow a presentation of such narrative to the patient herself, in order to receive their feedback on how their personal history has been portrayed.

Figure 5 provides an illustration of narrative generation from online questionnaires. The main mechanism consists in parameterizing typical clinical actions with some affective dimensions that can be associated to the questionnaire options. This association can be more or less explicit and this strategy is still part of ongoing research. A basic range of actions are provided as part of the representation of the several stages of the patient care pathway during their outpatient appointments or longer stays in the hospital. Here, we consider the early stage of assessment by the physician, which is an essential part in the patient’s experience. The figure shows two PDDL-based representations of variants of the same action that can be used by the narrative generation process. Each of the operators is generically named “op: assess-patient” with a specific parameter “sympathetically” and “indifferently” which relates to a single aggregated dimension deriving from the analysis of the questionnaire. The PDDL formalism defines action representation taking a set of input parameters, a set of pre-conditions for the action to be validated and a set of post-conditions or effects which describe the modifications affecting the overall narrative generation process. This formalism makes it possible to build causal chains from elementary actions and is at the heart of narrative generation. The set of parameters, which account for the diversity of instances, include which physician the patient was examined by, in which location (patient-room, examination-room, etc), and the aggregated dimension level which maps against the patient’s perception of the physician attitude towards her as extracted from the questionnaire. The parameterization of action representations controls the actual visualization and staging of that action, which comprises two levels. The first level is constituted by the actual selection of characters (medical staff and patient) and location...
that can vary for a given instance of the action (examination, interview …). The second level corresponds to the actual dramatization of the action, trying to visualize the perceived atmosphere. For instance, the staging of the patient assessment by an “indifferent” physician rather than a “sympathetic” one corresponds to different non-verbal expressions for the physician’s character, which are not reduced to facial expression but extend to aspects such as duration of some sub-actions, proxemics and general pacing of the action.

**Conclusion**

We have presented work in progress to support Narrative Medicine in non-textual media. While this may depart from some of the founding assumptions of Narrative Medicine, including the development of a narrative competence in physicians through writing [2], we believe this is compensated by the benefits offered by digital media in terms of automatic generation and retrospective analysis. The former could make the user base broader and the latter could support group work and in-depth analysis of the narrative accounts, opening new areas of investigation. Our approach is also consistent with the previous use of filmic media to illustrate some Narrative Medicine concepts [16]. There have been significant developments in recent years in the use of Interactive Narrative technologies for both training [14] and entertainment [11] applications, and these should equally support the development of virtual narrative medicine.
References

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